

the great value to the community of universities endowed from State funds may lead them to emulate American practice in this respect.

THE regulations for secondary schools (Cd. 3592) issued by the Board of Education, to come into force on August 1, mark a distinct advance in educational administration. More elasticity is to be allowed in the Board's dealings with secondary schools; more encouragement is to be given to local initiative and local effort; and certain defective features in older regulations are removed. The additional funds now available for secondary education have made it possible to abolish the limited four years' course on which alone grants have been paid hitherto. A uniform grant will in future be paid on pupils between twelve and eighteen years of age who are following an approved curriculum, and, what is of prime importance from the point of view of the schoolmaster, the term instead of the year is to be taken as the unit in assessing grants. The subjects to be studied and the time to be devoted to each has in the past been prescribed by the Board; for the future the head teacher and local authorities are to be encouraged to submit to the inspector for approval courses of work designed precisely to suit local needs and conditions. In the payment of grants it is interesting to note that the Board is prepared in certain cases to augment the grant due to a school by a further sum towards meeting expense incurred by the school in respect of approved educational experiments. There is ground for hope that this arrangement may hasten the methodical building up of a science of education. This adoption of the plan followed in all other scientific work of basing conclusions upon experiment and observation should lead to many improvements, and it is to be hoped that much thought and the best talent will be devoted to the inauguration of the age of scientifically arranged experiments in education. The regulations will, if sympathetically and intelligently interpreted, greatly improve English secondary education.

## SOCIETIES AND ACADEMIES.

### LONDON.

**Royal Society, June 6.**—"The Mechanical Effects of Canal Rays." By A. A. Campbell Swinton. Communicated by Sir William Crookes, F.R.S.

This investigation was undertaken in order to discover whether the so-called canal rays, which at suitable pressures can be seen streaming through the apertures in a perforated kathode, backward away from the anode, share with kathode rays the property of causing small and light mill-wheels to rotate.

Experiments were conducted with tubes in which there were a number of perforations in the kathode, so that the canal rays, after passing through these, impinged on the vanes of a mill-wheel of screw-propeller form, and also with other tubes in which there was only a single perforation in the kathode, and the canal rays acted on the vanes of a mill-wheel of water-wheel type. In both these forms of tubes mill-wheels with vanes of mica, as also with vanes of aluminium, were employed, and in every case rapid rotation of the mill-wheel occurred at suitable pressures in the direction corresponding with that of the canal rays. That this was due to the canal rays was proved by closing the apertures in the kathodes by means of aluminium shutters, when rotation could not be produced, as also by subjecting the tube to a powerful magnetic field so as to deflect to one side all direct or reflected kathode rays.

Experiments were also made with screw-propeller mill-wheels mounted in front of the kathode. In this case, when the vanes of the mill-wheel were of mica, the rotation obtained always corresponded with the result being due to bombardment by kathode rays proceeding away from the kathode; whereas, when the vanes were of aluminium, rotation in the contrary direction invariably took place, this corresponding with the effect being due to canal rays proceeding towards the kathode.

It was further ascertained by means of two thermojunctions of Constantan copper—one on each side of a mica vane, arranged so as to oppose their E.M.F.'s, and connected to a mirror galvanometer—that under canal-ray

bombardment the two sides of a mica vane may acquire differences of temperature amounting to as much as 200° F. It is suggested that the heat insulating properties of mica and the high thermal conductivity of aluminium have probably an important bearing on the divergent results obtained with these two materials, as mentioned above.

**Physical Society, June 28.**—Prof. W. E. Ayrton, F.R.S., past-president, in the chair.—Experiments on the production of sand ripples on the sea shore: Mrs. Ayrton. The sand-ripples of the sea-shore, although parallel to the line of the breakers, are not produced by their edges, but entirely under water. The long see-saw motion of the water produces the ripples, as was observed in 1882 by Mr. A. Hunt. To show this a glass trough, in which was level sand, covered with a foot of water, was pushed to and fro on rollers. This motion set the water oscillating, and soon small ridges were seen in the sand, at nearly equal distances from one another, growing larger as the oscillation continued. By deduction from the shape of certain sand vortices, it appears that every ridge in otherwise smooth sand must produce two other ridges, one on either side of the first, and that these two give rise to two other ripples, until the whole becomes ripple-marked. Experiments were shown to demonstrate this fact. To show that the vortices generated by the original ripple swept out those succeeding, an artificial barrier was put across the trough to increase the size of the vortices, a handful of moist black pepper was thrown in, and the water oscillated. Immediately the actual process by which the water started and built up the ripples was shown. The way was illustrated in which the ripples on the sea-shore could be imitated, even when the water ran in one direction alone, if only the sand were sloped so that the water ran up it, and if, by means of a paddle, a series of waves were sent along the water in the direction in which it was running. The whole of the sandy shore is ripple-marked when the tide is high, but the waves at the edge of the retreating tide wipe out the ripples except where there is a pool, so that the water is left over the ripples until after the sea has retired. The greatest depth at which ripple-mark can be formed at the bottom of the sea depends on the violence of the motion of the water. At depths of 60 feet or 70 feet the sand is said to have been found ripple-marked. If the depth of a vessel is large compared with its cross-section, a depth of water can be found beneath which no sand-ripples can be formed. On sprinkling a little sand in the water in a small trough, and rocking it to and fro, the sand was seen to assemble quickly in a straight line across its middle. Watching these grains, it was noticed that the result arose from every swing carrying each grain on one side of the centre nearer to the middle than the next swing carried it away again. Each ripple as a whole tends to move towards the middle of the trough. In troughs, the water was kept oscillating so as to form a stationary wave twice the length of the trough, and the place where the heap of sand was formed was where the level of the water changed least, and its horizontal velocity was the greatest. Referring to the Goodwin Sands, Mrs. Ayrton said she found it impossible to avoid recognising the resemblance between the hillocks and hollows of these sands and those made in her glass troughs, and it seemed possible that they were also produced by stationary waves.

### CAMBRIDGE.

**Philosophical Society, May 20.**—Dr. Hobson, president, in the chair.—Exhibition of photomicrographs of wood-sections made by Mr. J. A. Weale: E. R. Burdon. —Parasitic trees of southern India: C. A. Barber. The sandal tree, *Santalum album*, was discussed; although a large tree with abundant foliage and thick stem, it is dependent for its water and mineral salts on the roots of other plants. The disease called locally "spike" was illustrated by a series of lantern-slides. Four genera of Olacaceæ, *Olax*, *Ximenia*, *Opilia*, and *Cansjera*, large green climbers or shrubs, are now known to be parasitic like the sandal. The arrangement of the subgroups of the Olacaceæ has been unsatisfactory for a long time. The study of the haustoria endorses the arrangement proposed by Van Tieghem whereby the *Opiliæ* are transferred to near the *Santalaceæ*. Special attention was directed to the

presence of a complicated gland in the haustoria of *Santalum album* not hitherto described in any root-parasite. The gland is present in most, if not all, of the haustoria dealt with. Diagrams were shown of the haustoria of *Thesium Wightianum*, *Buckleya Quadriala* from Japan, *Osyris arborea*, *Cansjera Rheedii*, *Ximenia americana*, *Olax scandens*, and *Opilia amentacea*.—Physiology of plants in the tropics: A. M. **Smith**. (a) The internal temperature of leaves under tropical insolation. In still air, with black bulb vacuum thermometer at from 55° C. to 62° C., the air temperature in the shade being from 25° C. to 28° C., and the humidity about 70 per cent., leaves, whether thick and fleshy, or thinner and coriaceous, or thin and pliable, when placed normal to the sun's rays reach a temperature of 15° C. above that of the surrounding air, a temperature often considered injurious to the functions carried on in the leaf. In the shade the internal temperature varies from 1°·5 below to 4° above that of the surrounding air. Breezes reduced the temperature in the sun by amounts varying from 2° C. to 10° C. An attempt was made to estimate the magnitude cooling due to transpiration. Two leaves with stomata outwards were consistently lower in temperature than two with their stomatal surfaces facing each other. The difference was on an average 2°·5 C. Investigations into leaves with red or red-brown colouring matters showed that the red pigment raised the internal temperature of the leaf from 2° C. to 4° C. above that of similar leaves which were white or nearly so. (b) Periodicity of growth in Ceylon. Monthly observations showed that there was the largest amount of young growth in February, the driest month of the year. The theory is suggested that only then is there sufficient transpiration to supply the necessary mineral food for rapid growth. (c) Respiration of *Hydrilla verticillata*, a tropical water-weed. Values for the respiration from 7° C. to 50° C. were obtained. These when plotted produce a curve which shows increase of respiration with temperature according to the van 't Hoff rule, the coefficient for an increase of 10° C. being 2·2. The values go on increasing up to the death-point of the plant.—Notes on the parasitism of Botrytis: F. T. **Brooks**. The conidia of Botrytis are unable to infect healthy green leaves, whereas if a young mycelium, nourished saprophytically, is placed upon a normal leaf of such a plant as lettuce, infection rapidly spreads. Experiments have been undertaken to ascertain whether the conidia can cause the infection of weakened plants. Lettuce plants were grown in sterilised sand, watered from time to time with mineral solutions. After these plants had been growing six weeks the conidia had no power of infecting them. By tearing healthy green leaves of lettuce plants direct infection is caused by placing the spores upon the torn portion. The conidia are able also to infect leaves just beginning to turn yellow.—A representation of the exponential function as an infinite product: G. B. **Mathews**.—Some theorems on integral equations: H. **Bateman**.—The theory of the rotation of the plane of polarisation by solutions: Prof. **Thomson**.

## EDINBURGH.

**Royal Society**, June 10.—Dr. Robert Munro, vice-president, in the chair.—A contribution to the craniology of the natives of Borneo, the Malays, the natives of Formosa, and the Tibetans: Sir William **Turner**. The paper contained a full discussion of the characters of the skulls of the various peoples and races inhabiting the regions named; and one fact of general significance was the prevalence of the dolichocephalic type in the people of the interior of Borneo, Sumatra, Formosa, and the Philippines, and in the inhabitants of eastern Tibet, while the brachycephalic skull was characteristic of the sea-board peoples.—The histology of the Ephedrae, with special reference to the value of histology for systematic purposes: R. J. D. **Graham**. The primary structures of sixteen species or varieties were examined. The outer walls of the epidermal cells have a middle stratum containing crystals of calcium oxalate. Certain papillose epidermal cells act as ocelli, giving the light-spot and image described by Haberlandt for leaves. The cortex is differentiated into an outer palisade and inner lacunar chlorenchyma. The stereon system is built on a girder principle, the outer

flanges of each girder hypodermal, the inner pericyclic. Tannin sacs occur in the pith and cortex. The stellar system resembles somewhat that of Equisetæ, but differs in each leaf having two bundles which extend through two stem internodes. The characters which the author regarded as of use in determining subgeneric groups and in distinguishing varieties were the stereon distribution and degree of development, the distribution of the tannin sacs, and partially the character of the stellar system taken at a given level (the second internode below the apical bud).—The variation of Young's modulus under an electric current: H. **Walker**. Wires of steel, iron, platinum, and copper were heated by an electric current of gradually increasing and decreasing strength, and corresponding measurements of Young's modulus made. In steel, iron, and copper there was a decrease in the modulus for weak currents, then an increase to a maximum as the current increased and the temperature rose, finally falling off again as higher temperatures were reached. The return for decreasing currents followed a somewhat similar course, but not coincident with the course of the change during the increasing current. In the case of platinum, there was no initial decrease of the modulus for weak currents.

June 17.—Prof. A. Gray, F.R.S., vice-president, in the chair.—At the request of the council, Baron **Kikuchi** gave an address on Japanese national development, more especially with reference to education. The main purpose of the address was to show that the Japanese national spirit, which consisted of intense love of country and reverence for the Imperial house, had remained intact through the long centuries of change and growth, largely influenced as these had been by Chinese literature and philosophy, Indian religion, and in later days by Western learning.

June 24.—Dr. R. H. Traquair, F.R.S., in the chair.—The evolution of the eyebrow region of the forehead, with special reference to the significance of its excessive development in the Neanderthal race: Prof. D. J. **Cunningham**. The usual types of supra-orbital arch in recent man are what are seen in the baboon. The Neanderthal type, which approximates to that of the anthropoid apes, is also to be found, but rarely in a highly developed state, in individual members of certain races such as the Aboriginal Australians and New Guineans, and the Maories. These facts, which have an important bearing on Schwalbe's recent theories, were fully demonstrated from specimens by means of ordinary photographs and Röntgen-ray photographs.—The origin of the amniotic and allantoic fluids: Prof. D. Noel **Paton** and Dr. B. P. **Watson**. Anatomical, pathological, and experimental evidence was brought forward in support of the view that both fluids are derived from the foetus and not from the maternal blood vessels, and as a result of an extensive series of chemical examination of the fluids it was concluded that they are both derived from the foetal kidneys.—The application of a differential densimeter to the study of some Mediterranean waters: J. J. **Manley**. The instrument is an adaptation of Hare's hydrostatic method for comparing the densities of two liquids, and was found to be capable of great accuracy. A series of results showed the effects of variation of temperature upon the relative densities of normal sea water.—The electric conductivity and angles of minimum deviation of ninety samples of sea water, and a comparison of these with the salinity and density: Prof. E. G. **Hill**. The purpose of the comparison was to see if these physical properties could be used for measuring the salinity and density. The conclusion was that, though the physical properties were not exact measures of the chlorine in sea waters, the differences between the values for chlorine calculated from the physical constants and that measured by titration were so small that for purposes of oceanography it may be assumed that the values are identical.

July 2.—Prof. Crum Brown, F.R.S., in the chair.—Address on the work at the solar observatory, Kodaikānal, S. India: Prof. C. Michie **Smith**. The address began with a discussion of the conditions which must be fulfilled by a good solar observatory, and of the practical difficulties in the way of realising these conditions. Kodaikānal, from its steady climatic conditions and its elevation, was probably on the whole as well fitted for this kind of work as any other single observatory. In some years there was



sunshine for 346 days out of the year. The general arrangements of the observatory were described, but especially the methods for conducting solar research. A series of spectroheliograms showing the distribution of calcium vapour in the sun's atmosphere was exhibited; also photographs of the sun's disc and of the marginal prominences. Some interesting questions were touched upon as to the interpretation of certain markings in the spectroheliograms

## DUBLIN.

**Royal Dublin Society, June 18.**—Dr. J. H. Pollok in the chair.—Injurious insects and other animals observed in Ireland during the year 1906: Prof. G. H. **Carpenter**. In addition to records of well-known orchard and forest pests, this paper gives an account of damage to barley by maggots of the small fly *Elachyptera cornuta*, and to young cabbage plants by grubs of the beetle *Psylliodes chrysocephala*.—The densities and specific heats of some alloys of iron: W. **Brown**. The author has investigated the change in the densities and specific heats of about fifty different specimens of iron alloyed with various percentages of carbon, manganese, nickel, tungsten, silicon, copper, chromium, cobalt, and aluminium. The more important results are graphed, and the effect of adding 1 per cent. of an element to iron estimated.—A simple and rapid method of determining the rate of absorption of oxygen by polluted waters: Dr. W. E. **Adeney**.

## PARIS.

**Academy of Sciences, July 16.**—M. A. Chauveau in the chair.—The structural stability of ethylene oxide: Louis **Henry**.—How far it is possible to justify the use of the arithmetic mean in calculations on the results of observations: Giovanni **Schiaparelli**.—A report on the scientific mission to the gardens and public zoological establishments of the United Kingdom, Belgium, and Holland: Gustave **Loisel**.—The method of M. Loewy for the study of divided circles: MM. **Gonnessiat** and **Drayet**. Results show that it would be a mistake to limit the use of the division to entire degrees, leaving the remainder to a simple interpretation; this would involve, even in the mean of six microscope readings, errors of more than 0.2. —The surfaces generated by a circular helix: M. **Barré**.—Remarks on the theorem of Jensen: C. **Carathéodory** and L. **Féjer**.—A fundamental problem in the theory of elasticity: A. **Korn**.—The difference of potential in an arc running continuously between metallic electrodes: C. E. **Guye** and L. **Zébrakoff**.—The influence of pressure on the absorption spectra of gases: A. **Dufour**. Some rays remain of the same wave-length under increased pressure; others are displaced in the spectrum towards the red, according as the pressure is increased. All sensible rays under pressure show the Zeeman effect to a very feeble extent.—Synchronising in multiple reflections: Henri **Abraham**.—The valency of the molecule in salt solutions deduced from the dispersive properties of the solution and the theory of electrons: C. **Chéneveau**.—The origin of series spectra: W. **Ritz**.—The scale of molecular weights of gases: Daniel **Berthelot**. The table of molecular weights defined by the densities of gases only represents a system of numbers, and must be fixed by relation to a gas of reference.—Some new characteristic constants of oils: E. **Louise** and E. **Sauvage**. Observation of the miscibility with acetone gives rapid determining characteristics for many oils.—The hydrolysis of iron perchloride: G. **Malfitano** and L. **Michel**. It is probable that the hypothetical products  $\text{FeCl}_2(\text{OH})$  and  $\text{FeCl}(\text{OH})_2$  exist, while  $\text{Fe}(\text{OH})_3$  can only exist temporarily in solution.—The production of high temperatures in laboratory research: C. **Chabrie**.—The analysis of selenium hexafluoride: Paul **Lebeau**.—Ethyl hexahydrobenzoylacetate: A. **Wahl** and A. **Meyer**.—The action of diazo-chlorides on  $\gamma$ -chloro-aceto-acetic esters: G. **Favrel**.—Triphenylcarbinol. The action of malonic and cyanacetic acids: R. **Fosse**.—The oxidation of oxyhaemoglobin: I. **Szreter**.—A contribution to the study of the brandies of Charentes: E. **Kayser** and A. **Demolon**.—The neo-volcanic formations anterior to the Miocene in the north-west of Sardaigne: M. **Depprat**. The first eruptions were characterised by the emission of rhyolites, but the greater part of the region

is marked by the presence of the less acid trachytes and andesites.—An investigation on the foreign fats in lard: Alexandre **Léys**. The fraudulent addition of oil to genuine lard only changes the melting point, without reducing the specific gravity.—The separation of odorous principles in plants: Eug. **Charabot** and G. **Laloue**.—Some new observations on the Carboniferous earths of the Sahara: G. B. M. **Flamand**.—Some experiments made with radium bromide: A. **Jost**.

## NEW SOUTH WALES.

**Royal Society, May 1.**—Prof. T. P. Anderson Stuart, president, in the chair.—Presidential address: Prof. T. P. Anderson **Stuart**. The address reviewed matters chiefly connected with medical questions. The true value of the Danysz rabbit experiments was set out, showing that, even if successful to the fullest possible extent, this method of coping with the pest would never be more than auxiliary to the methods already known and in use. The Danysz rat-virus, and its complete failure under the most favourable conditions, in New South Wales, was next described, and the question asked—if this virus has been such a failure, what grounds have we for expecting a better result with the rabbit-virus? The bubonic plague was referred to in connection with the recent report of the Indian Plague Commission, and the apathy of the people in Sydney as regards the destruction of rats was condemned. In connection with the death of Schaudinn, the discoverer of the *Spirochaeta pallida*, the long-sought virus of syphilis, the most successful experience of an entirely free and unrestricted treatment of female patients suffering from contagious diseases in Sydney was described. Reference was now made to the opsonin treatment, and to its introduction in Sydney at the Royal Prince Alfred Hospital. The movement for establishing a school of tropical medicine in Australia was fully discussed and commended.

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